

## REPORT DOCUMENTATION PAGE

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4. TITLE AND SUBTITLE An Improved SPH Technique for Fracture Modeling				5. FUNDING NUMBERS F49620-98-1-0148	
6. AUTHOR(S) Prof. Libersky Prof. Carney					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) New Mexico Inst. of Mining and Technology Research and Development Campus Station Socorro, NM 87801				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR 801 N. Randolph Street, Room 732 Arlington, VA 22203-1977				10. SPONSORING/MONITORING AGENCY REPORT NUMBER F49620-98-1-0148	
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12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for Public Release.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The purpose of the proposed research was to enhance the Smoothed Particle Hydrodynamics (SPH) code named MAGI. With these improvements, the MAGI code could solve the enormously complex problem of simulating Behind-Armor-Debris and subsequent interaction of the spall cloud with threat target components as well as the fragmentation of warheads and other explosively driven devices. The proposed work would have involved several improvements to the numerical implementation of SPH. This was possible, as two of the world's leading experts in SPH, Larry Libersky and Ted Carney, were employed by NMIMT/EMRTC and both contributed to the proposal. The PI's were intending to add contact and free-surface boundary conditions to the normalized version of MAGI. The one-dimensional case was completed when work was suspended. Unfortunately, by the time the contract was delivered, Larry Libersky had left EMRTC and Ted Carney resigned soon after. There were no other researchers at EMRTC that were competent to complete the contract, so the work was suspended and the contract terminated.					
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20. LIMITATION OF ABSTRACT					



## **AN IMPROVED SPH TECHNIQUE FOR FRACTURE MODELING**

Final Technical Report Submitted to:

AFOSR/NM  
110 Duncan Avenue, Room B115  
Bolling AFB, DC 20332-8050

Grant No. F49620-98-1-0148

**DISTRIBUTION STATEMENT A**  
Approved for Public Release  
Distribution Unlimited

Energetic Materials Research and Testing Center  
New Mexico Tech, Socorro, NM 87801

June 15, 2000

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## REPORT OF INVENTIONS AND SUBCONTRACTS

(Pursuant to "Patent Rights" Contract Clause) (See Instructions on Reverse Side.)

				Form Approved OMB No. 0704-0240 Expire June 30, 1992			
				3. TYPE OF REPORT (X one) a. INTERIM <input checked="" type="checkbox"/> b. FINAL <input type="checkbox"/> 4. REPORTING PERIOD (YYMMDD)			
a. FROM 1997/12/01 b. TO 1998/03/31							
<b>SECTION I - SUBJECT INVENTIONS</b>							
5. "SUBJECT INVENTIONS" REQUIRED TO BE REPORTED BY CONTRACTOR/SUBCONTRACTOR (If "None," so state)							
a. NAME(S) OF INVENTOR(S) (Last, First, MI)		b. TITLE OF INVENTION(S)		c. DISCLOSURE NO. PATENT APPLICATION SERIAL NO. OR PATENT NO.		d. ELECTION TO FILE PATENT APPLICATIONS (1) United States <input type="checkbox"/> (2) Foreign <input type="checkbox"/> (a) Yes <input type="checkbox"/> (b) No <input type="checkbox"/> (c) Yes <input type="checkbox"/> (d) No <input type="checkbox"/> (1) Yes <input type="checkbox"/> (2) No <input type="checkbox"/>	
NONE							
f. EMPLOYER OF INVENTOR(S) NOT EMPLOYED BY CONTRACTOR/SUBCONTRACTOR							
g. ELECTED FOREIGN COUNTRIES IN WHICH A PATENT APPLICATION WILL BE FILED							
(1) Title of Invention (2) Foreign Countries of Patent Application							
(1) (a) Name of Inventor (Last, First, MI)							
(b) Name of Employer							
(c) Address of Employer (Include ZIP Code)							
<b>SECTION II - SUBCONTRACTS (Containing a "Patent Rights" clause)</b>							
6. SUBCONTRACTS AWARDED BY CONTRACTOR/SUBCONTRACTOR (If "None," so state)							
a. NAME OF SUBCONTRACTOR(S)		b. ADDRESS (Include ZIP Code)		c. SUBCONTRACTOR NO. (S)		d. DFAR "PATENT RIGHTS" (1) Clause Number <input type="checkbox"/> (2) Date (YYMM)	
NONE							
e. DESCRIPTION OF WORK TO BE PERFORMED UNDER SUBCONTRACT(S)							
f. SUBCONTRACT DATES (YYMMDD)							
				(1) Award <input type="checkbox"/> (2) Estimated Completion			
<b>SECTION III - CERTIFICATION</b>							
7. CERTIFICATION OF REPORT BY CONTRACTOR/SUBCONTRACTOR (Not required if Small Business or Non-Profit organization.) (X a)							
c. I certify that the reporting party has proceeded for prompt identification and timely disclosure of "Subject Inventions," that such procedures have been followed and that all "Subject Inventions" have been reported.							
d. SIGNATURE  W.D. Peterson							
e. DATE SIGNED <b>4/19/00</b>							
b. TITLE Vice President for Admin & Finance							
f. Previous editions are obsolete.							

  
**New Mexico Tech**  
**Energetic Materials Research and Testing Center**  
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June 15, 2000

DEPARTMENT OF THE AIR FORCE  
Air Force Office of Scientific Research / NM  
110 Duncan Avenue Room B115  
Bolling AFB, DC 20332-8050

RE: F49620-98-1-0148  
Final Technical Report  
Final Invention Report

Enclosed are the final reporting requirements under the referenced contract. New Mexico Tech and EMRTC appreciate your research opportunities and would like to work with you again in the future.

The Technical Report is limited to the initial work began by the Principal Investigator, T. Carney. He left New Mexico Tech, and therefore, was unable to complete the entire contract requirements.

If you need additional information, contact Gayle Jones at 505-835-5810.

Sincerely,



W.D. Peterson  
Vice President for Admin. & Finance  
NMIMT

xc: W. Veon  
L. Sakell